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METHOD AND APPARATUS FOR MOBILE WIRELESS COMMUNICATION

CROSS-REFERENCE TO RELATED APPLICATION

10 Priority is claimed from U.S. provisional application no. 60/198,177, filed April 19, 2000.

BACKGROUND OF THE INVENTION

15 The invention generally relates to a mobile wireless communication system. In particular the invention relates to a satellite-based mobile wireless communication system having a relational database and to a method and apparatus for maintaining the database current in the face of interruptions in communication.

20 Freight carrying operations, and in particular, trucking operations in today's environment are growing increasingly expensive to use and thus are forcing on the trucking companies increasingly efficient methods of operation. Some trucking companies are now using global positioning systems attached to their trucks including transponders or antennas, which will enable the trucking companies to determine the location of the trucks.

25 Other companies have attempted to automate at least part of the paper handling associated with the trucking company, for instance. It is known that company's such as United Parcel Service have large easel-type computer systems for entry of signatures thereon and verification that products have been received. In addition, trucking and freight forwarding companies often rely on the use of bar codes to track shipments through client server networks in order to determine the location of goods and services.

30 Oftentimes, however, even with these added features, it is difficult to handle the flow of information efficiently for

5 shipping operations. For instance, it may turn out that a
truck driver is to pick up twelve pallets of a particular
freight shipment from a company. A driver arrives at the
company and is told that he is only to pick up ten pallets.
He makes a separate notation because the freight bill should
10 not be changed indicating that he has received less than the
full load, and that hand written notation must later be
reconciled through a number of steps between the trucking
company, or shipper and the company whose product is being
shipped. This is time consuming and wasteful.

15 Another problem that trucking companies are currently
faced with is the recruiting of drivers when there is a high
competition for drivers. It is often almost impossible to
recruit drivers reliably as by the time employment application
form is filled out, and transmitted through the trucking
20 company's internal business systems, the driver may have been
hired by a competing company.

In addition, while some wireless communication systems
have been provided to trucks, the communications are
geographically spotty and in some cases also run at relatively
25 low data rates limiting the amount of data that can be sent to
the truck or received from the truck and the flexibility of
the system. In addition, the system often requires that a
driver may have to physically plug a link into a wall socket
or the like to obtain access to a telephone system or network
30 which would necessitate stopping the truck, parking the truck
for a certain limited period of time in order to transfer the
data.

Thus, what is needed is a wide area coverage system with
rapid information updating and convenient linking to a truck
35 driver so that the information may be transmitted as near as
possible as real time fashion from the driver to the trucking
company and from the trucking company back to the driver.

SUMMARY OF THE INVENTION

5 A method and apparatus embodying the present invention
comprised of a hub server for storing trucking and shipping
information such as electronic freight bills, driver
employment forms, and the like in electronic format. The hub
server stores the information in relational database that is
10 updated periodically via communications through a satellite
ground station. The satellite ground station communicates
with an earth satellite which communicates with multiple
ground stations at various locations connected to truck stop
servers which function as proxy servers. Each of the truck
15 stop servers has associated with it a spread spectrum
communication system which can communicate via spread spectrum
through wireless modems connected to personal digital
assistance or laptop computers being used by truck drivers.
In addition, the hub server may be connected to customer
20 servers and to third party servers to exchange information
regarding shipments with them.

The system embodying the present invention includes
system level applications including the ability to detect
network access, a PDA-based web browser and an e-mail client
25 which may communicate over the system assets. Routines also
execute processes, for instance, sending and receiving e-mail,
executing database modifications and queries, executing queued
applications and the like. This provides a drive-by feature
which will enable truck drivers and others to communicate with
30 the network without the necessity of stopping at a wireless
local area network location. In addition, the system includes
a web browser which is compatible with standard personal
digital assistants and standard TCP/IP HTTP/HTML browsers.
The browser is capable of caching web pages for offline
35 viewing and allows real-time access to online forms. The
browser supports cookies and and SSL technologies by using a
proxy server that resides on a node server.

A PDA-compatible e-mail client also functions on the
network. Specific features of the client will include the

5 ability to download email from truck stop server mail servers
allowing POP/SMTP access. The ability to link to address
books and an option to download email headers only for compact
display. In addition, leave message-on-server activities are
supported.

10 More specifically, trucking companies can send pay
settlements and pay stubs to drivers over the network in order
to provide timely detailed descriptions of the drivers pay.
This will reduce operating costs through the elimination of
long distance calls to trucking company payroll departments.
15 The system may be integrated with trucking company application
servers, typically IBM AS-400 computers in order to
automatically generate formatted email pay settlements.

20 An authorized fuel network application enables trucking
companies to inform drivers in real time over the network of
fuel network changes including changes in fuel pricing.
Drivers are able to receive directions over the network to
fuel stops as well as listing of amenities thereat. This
enables trucking companies to save significant amounts of
money by utilizing appropriate fuel stops with low prices and
25 receiving the most current and lowest pricing available. The
fuel network application is managed and updated through a web
browser interface as necessary by trucking company fuel
managers.

30 Truck maintenance tracking is also available. Maintenance
information is entered and transmitted wirelessly to a fleet
maintenance department of the trucking company over the
network for recording. The driver or company receives
notification through a PDA or through a hub server of upcoming
scheduled maintenance. The database has regularly performed
35 maintenance and time or mileage intervals available. The
database may be customized by individual trucking companies to
enter their own maintenance schedules.

Local condition reporting may be performed over email. A
driver uses his PDA to send email to a maintenance facility

5 warning that there is a problem that needs attention. This enables a maintenance bay to be reserved before the driver arrives at the facility, thereby saving time.

10 Part of the database information to be made available from the hub server will be indications of freight which is to be hauled. The users have the ability to enter specific search criteria including starting location, destination, trailer type, availability, time and date. Once entered, the search criteria are compared to third party load databases through the hub returning matching loads, as indicated through the PDA. The driver may then have discretion selecting a load.

15 Electronic freight bills will be prepared by the system and will enable drivers to electronically exchange freight bills with the trucking company, shippers and consignees. Electronic freight bills complete a logistic chain by providing both in-transent visibility and data integrity throughout a shipping cycle.

20 Electronic employment applications are also handled by the network and may be completed by driver applicants on hand-held computers such as PDA's or laptops. The application is in a wizard format and captures the applicant's signature. Once complete, the recruit's application and signature are sent electronically over the network to the trucking company's recruiting office for rapid processing. Individual trucking companies may customize at least a portion of the employment application and input the recipient's email address, track sender information, and integrate it into existing services.

25 Electronic driver logs are handled by the system, wherein drivers through their PDA's will enter time and activity, including driving, sleeper berth, off duty or on duty, not driving. The software will verify that all hours are legal. After entry of the information in the PDA or laptop, a graphic similar to paper logs will be displayed on the PDA or laptop computer. The log book entry will then be delivered

5 electronically to the trucking company over the network for
recording in the trucking company databases. The log entries
will include the date, including month, day and year, the
vehicle number, driver I.D., the miles driven that day, the
name of the carrier or carriers, the main office address, the
10 home terminal address, name of co-driver, if any. Including,
in addition, the hourly entries will have descriptions
associated with them including city, state, shipping yard
activity, loading, unloading, fueling and the like.

15 In order to carry out all of the above tasks, a database
replication system is provided by the apparatus and method
embodying the instant invention. For scheduling large bursts
of data so that when satellite connections are created an
efficient use of network resources can be obtained. Between
the bursts of data, all data remains available at all access
20 points on the network. Race conditions are eliminated by
conflict resolution logic built into the server and client
side applications.

25 A central controlling server or hub functions as a master
synchronizing system for all external access points or truck
stop stations (TSS). If a change occurs in the database
located in the hub, the change is broadcast to all the TSS.
If a change occurs in the database located on one of the truck
stop servers, then that change is sent back to the hub and
then broadcast to all of the stations. All broadcasts are
30 sequenced in a manner similar to that done for transmission
control protocol packets for error correction so that the
broadcast provides a reliable transport method for all
systems. A satellite network compatible with television
signals allows six megabit per second bursts to all stations
35 on the hub. TSS stations communicate back to the hub using a
6K per second data rate. The data moving from a TSS back to
the hub is relatively small compared to the outbound data from
the hub. By design the network only allows forty connections
to be created from TSS stations to the hub. This has the

5 benefit that it will guarantee that the hub will not be
overrun by communication requests from the TSS station.

The satellite communication is run over a Cislunar
Networks system using compression technology that allows data
to be efficiently transmitted at low cost. Each of the
10 wireless local area network (WLAN) sites is comprised of a
proxy server or TSS and wireless access points. The server
enables local storage and rapid access to very large amounts
of data. This combination of truck stop server and wireless
access points enables information to be accessible by network
15 subscribers from within their vehicles, local restaurants, and
the like without being required to send and receive
information over land lying communications. The wireless LAN
network implements IEEE 802.11b wireless technology using
spread spectrum technology.

20 This communicates wirelessly to PDAs which, in the
present embodiment, are Palm-OS units or devices which are
compatible therewith. In the alternative, a Symbol 1740
wireless Palm OS computer may be used. In order to provide
security the software performs 128 bit encryption on data
25 being transferred between servers. Encryption is based on 64
wired equivalence privacy standards and uses a 40 bit secret
key plus 24 bit initialization vectors.

It is an aspect of the present invention to provide a
complete end-to-end wireless communication system for use in
30 the trucking industry to allow truck drivers to quickly and
effortlessly communicate trucking related information as well
as personal information via email and web browser with a hub
server which may be connected to a variety of trucking company
servers and third party servers.

35 It is another aspect of the present invention to provide
communication which is wireless and need not be linked to
ground-based systems.

It is a still further aspect of the present invention to
provide a wireless trucking information communication system

5 which provides rapid and accurately real-time data updating
over satellite communications.

Other aspects of the invention will become obvious to one
of ordinary skill in the art upon a perusal of the following
specification and claims in light of the accompanying
10 drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block of an apparatus embodying the present
15 invention;

FIG. 2 is a block diagram showing the relationship
between the hub server and a customer network and the
internet;

FIG. 3 is a block diagram of a link between a hub server
and a satellite system to a truck stop server and network
connections to wireless access points;

FIG. 4 is a block diagram of the connection from a
satellite receiver to truck stop servers and personal digital
assistants and laptops;

FIG. 5 is a block diagram of the contents of a
25 synchronization packet;

FIG. 6 is a flow chart showing details of information
provided for electronic driver load indications;

FIGS. 7A and 7B are a table of the types of descriptions
30 of equipment which is stored in the database and handled by
the PDAs;

FIG. 8 is a flow chart of the manner in which an
electronic log is kept;

FIG. 9 is a flow chart of the handling of an electronic
35 flat belt;

FIG. 10 is a flow chart showing steps of incoming data
management for a hub;

FIG. 11 is a flow chart showing steps of outgoing data
management for a hub;

5 FIG. 12 is a flow chart showing steps of incoming data management for a truck stop server;

 FIG. 13 is a flow chart showing steps of outgoing data management for a truck stop server;

10 FIG. 14 A and 14 B are renderings of screens for the preparation of electronic freight bills; and

 FIG. 15 is a rendering of the driver application screens presented on a personal digital assistant or laptop computer for transfer of data via truck stop server to a hub.

15 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and especially to FIG. 1, an apparatus that is generally referred to by reference numeral 10 and embodying the present invention is shown therein. The central hub server 12 which includes a web server having a data synchronization system, a database and an interface 13 is connected to a satellite teleport 14 which is able to communicate with an earth satellite 16 with a type which carries television transmissions. In this case it is a GE4 satellite. The satellite also sends signals to a satellite teleport 18 which is a ground-based station connected over a link to a local node server or proxy server or truck stop server (TSS) 20 which also includes system synchronization process software as well as a TSS database. Multiple TSSs are connected to the system at various truck stops. The proxy server can communicate a portion of its database information to a wireless access point which is a spread spectrum transceiver system communicating using IEEE802.11b protocols with a hand held computer 24 which may comprise a palmar S device, a Windows CE device, etc. including a wireless modem therein which is compatible with 802.11. In addition, information from the hub server may be shared with a company network 26 which may communicate via the Internet 28 to company customers through an Internet service

5 provider 30 which is coupled to a customer network 32. The
customer network 32 includes customer data 34 which may be
related to trucking company data, advertising data, etc. The
customer network has connected to it a customer gateway server
10 and storage for intermediate data for manipulation in other
instances.

Referring now to Fig. 9 an incoming data management flow
for the hub is shown therein, including a step 100, which the
hub incoming data manager receives updates over the satellite
network from a truck stop server. In a step 102 the data is
15 placed in an incoming cubed table. In a step 104 the hub cube
manager monitors the queue for arriving updates and checks for
sequential updates in a step 106. In a step 108 the system
checks for sequenced group updates in order to ensure the
groups contain the correct number of entries which are
20 expected. In a step 110, the updates are applied to the
database assuming that the sequence group updates and the
sequential updates were in order. In a step 112, the update
entries are placed in a hub outgoing queue. In the event that
the sequential update check is not passed in step 106, a
25 request is made in a step 114 directly to the TSS for missing
data. The hub is then contacted but responds with no data in
a step 116 and generates an administrative message in a step
118. In a step 120 the missing record or group is ignored and
the process continues. In the event that the sequence group
30 update check of step 108 fails, the request is made to the TSS
for the missing data, which is similar to the step 114 in a
step 122. The TSS responds with the missing records in a step
124, and transfers control back to the step 110.

For outgoing data management, as may best be seen in Fig.
35 11, in a step 130, the hub outgoing data manager monitors an
outgoing queue. In the step 132, a log is checked for the
last broadcast sequence number. In step 134, a broadcast
sequential update and group entries to all TSS systems via
packet broadcast across the satellite network takes place and

5 then in a step 136, the update entry is moved to a revolving
history table. In addition, in the step 138, the hub listens
for direct incoming requests for missing update entries and
receives requests from the TSS from the missing entries in a
step 140. A lookup update occurs in a step 142 history table
10 if the entry is not found and no response is sent to the TSS
in the step 144, if the entry is found, a request is sent back
to the TSS in a step 146.

15 The truck stop server incoming data management is
handled, as may best be seen in Fig. 12, in a step 150, an
incoming data manager receives updates from the hub server in
a step 152, the data is placed in an incoming queue table. In
a step 154, the TSS queue manager monitors the queue for
arriving updates in a step 156, sequential updates are
checked. If the sequential updates check fails, control is
20 transferred to a step 158 causing a request to be made
directly to the hub for the missing data. In a step 160, the
hub is successfully contacted but responds with no data and
generates an administrative message in step 162, causing the
missing record or group to be ignored in a step 164, and
25 control to be transferred back to step 154. In a step 166, a
check is made for sequence group updates in order to ensure
that the groups are complete and contain the correct number of
entries. In the event that the check fails, control is
transferred to a step 168 which requests data from the hub,
30 and the hub responds in a step 170, with the missing records
transferring control to a step 172, wherein entry is checked
to see if the origin TSS I.D. is the current TSS. The updates
are applied to the database in a step 174, and entries are
removed from queue and store in a revolving history table
35 which is not allowed to be older than thirty days in a step
176.

The TSS outgoing data management is handled as may best
be seen in Fig. 13, wherein a step 180 the TSS outgoing data
manager monitors an outgoing queue. In a step 182, the log is

5 checked for the last update entry sequence number. In a step
184, the outgoing queue is checked for grouped entries. In a
step 186, a sequential update and grouped entries are sent to
the hub system by a transmission control protocol across the
satellite portion of the apparatus 10. In a step 188, the
10 update entry is moved to revolving history table. In
addition, the TSS listens for direct incoming requests for
hub, for missing update entries in a step 190. If a request
is received in a step 192, a step 194 is executed causing a
lookup update entry in the history table. If the entry is
15 found in a step 196, the information is sent back to the hub,
if the entry is not found, a no response is sent to the hub in
a step 198.

Of the types of information which are sent, the
information is packaged as may best be seen in Fig. 6, where
the synchronization packet detail is shown with the
synchronization packet 200 comprising an SQL payload size
field 202, a packet type field 204, a sequence number 206, a
group sequence number 208, an origin TSS identifier 210, a
time stamp 212, a database name 214, a database user
25 identification 216, a database password 218, and finally the
SQL statement itself 220. Thus, it may be appreciated that
both group and sequence information as well as time stamping,
database naming and database user information and password is
transmitted in the synchronization packets. The
30 synchronization packets may be used to send electronic load
information as shown in Fig. 6, wherein a step 250, an
authentication is done, a match is checked for in a step 252,
and a load type is selected in a step 254. Connection may be
made to the driver in a step 256 allowing equipment to be
35 selected from a listing in a step 258, the origin city is
inserted in step 160, the origin state in a step 262, the
distance radius in a step 264, the destination city in a step
266. In addition, the destination state is inserted in a step
268 as well as the radius in a step 270, and the results are

5 compiled in a step 272. In addition, links can be made to a
fleet in a step 280, or to a fleet intranet in a step 282 to
forward the information, as well as the information being sent
over the internet in a step 286 to available websites in a
step 288. Equipment type may also be identified as set forth
10 in the tables in Figs. 7A and Fig. 7B identifying containers,
types of decks, bulk shipping, types of flatbeds, whether
hazardous material handling equipment is needed, refrigerated
equipment, tankers, vans, or specialized vans.

Furthermore, an electronic log book function is provided
15 as set forth in Fig. 8, at a log start time at a step 300, the
status, city, states, and notes may be entered in a step 302
for transmission. A test is made for a status change in a
step 304, a test is also made for last status off in a step
306 and whether last status is sleeper berth in a step 308.
20 In addition, a test is made to determine whether the last
status indicates driving in a step 310, if it is then a step
312 a test is made to determine whether the number of driving
hours since 8 hours rest exceeds ten hours. If it is, a
warning is issued in a step 314. If it is not, is the driving
25 hours plus the on hours, since eight hours rest greater than
sixteen as tested for in a step 316, if it is a greater than
fifteen hour warning is issued in a step 318. Control is then
transferred to a step 320, where a determination is made as to
whether a seventy hour warning needs to be issued, and if so a
30 seventy hour warning is issued in a step 322. Control is then
transferred back to a test step 324 to test for sleeper berth
and to an end of the day log in a step 326 which may loop back
to log start times, back in 300.

As may best be seen in Fig. 9, the carrier database 400
35 allows data to be automatically extracted and entered by a
gateway end server 402 or allows a fleet manager to enter data
via website 404. In step 406, data populates the hub database
and is then replicated to all of the truck stop stations via
the network. In a step 408, the driver information is

5 synchronized over the wireless local area networks and data is
downloaded to the end devices such as the PDAs or the laptop
computers. A test is made in the step 410 to determine if the
shipper information is complete, if not, control is
transferred to a step 412 prompting completion of the driver
10 shipper information. A test is made in a step 414 to
determine if the consignee information is complete, if it is
not, the driver or shipper completes the information in a step
416. If it is, control is transferred to a stop offs check
418 to determine whether that information has been entered, if
15 it has, the driver and shipper is prompted to complete it in a
step 420 and a ship operation signal is given in a step 422.

20 A driver consignee review may be made in a step 424. OSD
information is checked for in a step 426 and if it is not
present, the information is entered in a step 428. The
consignee can sign off in a step 430 after which the stop
officer identified in a step 432, and the data is stored until
the driver enters the wireless local area network in a step
434 where it can be downloaded.

25 Among the data which can be sent, it may best be seen in
Fig. 14A are electronic freight bills which include the
originators name, address, city, phone number and directions,
as well as consignee information including the destination
name, address, city, telephone number, zip code and directions
to the consignee. Carrier information may be provided, such
30 as the trucking company, the tractor number, the trailer
number, as well as a bill of lading menu to indicate whether
signatures are required, identify the load number. The bill
of lading will also identify the quantity, the description of
the material and the weight.

35 In addition, information can be sent over the network
related to a driver application, employment application form
is shown in Fig. 15, which may be completed over a PDA. As
shown, the PDA includes personal information, safety record,
current employer, screens drivers license information prompts,

5 types of training prompts and employment detail, even asking
for specific information such as histories of accidents,
citations received, driving under the influence offenses and
license suspensions and revocations. Finally, the PDA
provides a place for the applicant signature to be inserted
10 and digitized and forwarded to the hub.

While there have been illustrated and described
particular embodiments of the present invention, it will be
appreciated that numerous changes and modifications will occur
to those skilled in the art, and it is intended in the
15 appended claims to cover all those changes and modifications
which fall within the true spirit and scope of the present
invention.

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